D 103780 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2024

Physics/Applied Physics

PHY 2B 02/APH 2B 02/PHY 2B 22—MECHANICS—II

(2020—2023 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the question paper have their usual meanings

Section A (Short Answer Type)

Answer **all** *questions in two* **or** *three sentences.*
Each correct answer carries a maximum of 2 *marks.*

1. Most harmonic oscillators are damped and, if undriven, eventually come to a stop. Why ?
2. Define the time average of a function $f(t)$ with proper diagrams.
3. Explain Coriolis force. What is the effect of Coriolis force on wind moving over the surface of earth ?
4. Write a note on Galilean transformations.
5. Briefly explain the characteristic impedance of a travelling wave.
6. Explain the terms :
   (a) Apogee ; and
   (b) Perigee.
7. What is a harmonic oscillator ? Write down its differential equation.
8. Discuss the condition for nondispersive wave.
9. What is a central force ? Show that the motion of a particle under central force is always confined to a single plane.
10. Differentiate between dispersive and nondispersive sinusoidal waves.

Turn over

11. What are the two types of wave motion ?

12. What is a plane progressive wave ? Write down the general expression

(Ceiling - 20)

Section B (Paragraph / Problem Type)

Answer **all** *questions in* **a paragraph** *of about* **half a page to one page**.
Each correct answer carries a maximum of 5 *marks.*

13. A car hits a speed bump and the chassis is displaced by 1 cm. If the shock absorbers critically damp the resulting vibration, the car weighs 1000 kg, and the damping constant is b = 20000 kg/s, find the displacement of the chassis over time.

14. m = 2000 kg is in elliptic orbit about the earth. At perigee it has an altitude of 1100 km and at apogee (farthest distance from the earth) its altitude is 4100 km. Calculate the energy needed to put the satellite into orbit by neglecting losses due to friction.

15. Derive equation for transport energy of a wave

16. Find the spring constant $\boldsymbol{k}$ and damping constant $\boldsymbol{b}$ of a damped oscillator having a mass of 5 kg, frequency of oscillation 0.5 Hz, and logarithmic decrement 0.02.

17. Titan, the largest moon of Saturn, has a mean orbital radius of 1.22×10^9 m. The orbital period of Titan is 15.95 days. Hyperion, another moon of Saturn, orbits at a mean radius of 1.48×10^9 m. Use Kepler's third law of planetary motion to predict the orbital period of Hyperion in days.

18. Wite a note on undamped forced oscillator.

19. Briefly explain mechanical radiation pressure.

(Ceiling - 30)

Section C (Essay Type)

Essays.
Answer in about **two pages,** *any* **one** *question.*
Answer carries 10 *marks.*

20. What is forced Damped harmonic oscillator ? derive the equation. Give one example.

21. State and prove Kepler's laws of planetary motion. Prove third law.

(1 × 10 = 10 marks)

C 43200 **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2023

Physics/Applied Physics

PHY 2B 02/APH 2B 02—MECHANICS—II

(2020—2022 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the question paper have their usual meanings.

Section A (Short Answer Type)

Answer **all** *questions in two* **or** *three sentences.*
Each correct answer carries a maximum of 2 *marks.*

1. Define Lorentz contraction.
2. Differentiate between phase velocity and group velocity.
3. With example, define inertial frame of references.
4. State law of equal areas. How is it related to angular momentum ?
5. Define central force motion and list any two features of central force motion.
6. What is forced damped harmonic oscillator ? Write the expression.
7. Give the characteristics of Simple Harmonic Motion.
8. What are the condition for nondispersive wave.
9. State Fourier's theorem ?
10. A famous magic trick involves a performer singing a note toward a crystal glass until the glass shatters. Explain why the trick works in terms of resonance and natural frequency.
11. Explain the term resonance.
12. Define superposition of wave pulses.

(Ceiling - 20)

Turn over

Section B (Paragraph / Problem Type)

Answer **all** *questions in* **a paragraph** *of about* **half a page to one page.**
Each correct answer carries a maximum of 5 marks.

13. The equation of a damped simple harmonic motion is $m\,d^2x/dt^2 + b\,dx/dt + kx = 0$. Then find the angular frequency of oscillation.

14. Derive the equation for Energy Dissipation in the Damped Oscillator.

15. The centre of mass of a 1600 kg car is midway between the wheels and 0.7 m above the ground. The wheels are 2.6 m apart.

    (a) What is the minimum acceleration A of the car so that the front wheels just begin to lift off the ground ?

    (b) If the car decelerates at rate g, what is the normal force on the front wheels and on the rear wheels ?

16. Define central force. Give some examples of central forces and Examples of central forces are.

17. Define Q factor. Explain Q factor of any harmonic oscillator.

18. Write a note on normal modes.

19. With necessary derivations explain the energy in a mechanical wave.

(Ceiling - 30)

Section C (Essay Type)

Essays.
Answer in about **two pages,** *any* **one** *question. Answer carries* 10 *marks.*

20. Briefly explain the physics in a rotating system. Define Coriolis force.

21. Explain central force motion as a one body problem. Derive the general solution.

(1 × 10 = 10 marks)

C 23888 **(Pages : 3)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2022

Physics/Applied Physics

PHY 2B 02/APH 2B 02—MECHANICS II

(2020 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the question paper have their usual meanings.

Section A (Short Answer Type)

(Answer **all** *questions in two* **or** *three sentences.*
Each correct answer carries a maximum of 2 *marks.*

1. Define fictious force. Deduce an expression for the force experienced by a particle in a co-ordinate system with uniform acceleration A.
2. Explain Coriolis force. What is the effect of Coriolis force on wind moving over the surface of earth ?
3. Define inertial and non-inertial frame of references with proper examples.
4. Explain the terms :
   (a) Apogee ; and
   (b) Perigee.
5. What is a central force ? Show that the motion of a particle under central force is always confined to a single plane.
6. Write the equation of a forced damped harmonic oscillator and describe the terms involved.
7. Define :
   (a) Phase velocity ; and
   (b) Group velocity.
8. Discuss the condition for nondispersive wave.
9. Define the time average of a function $f(t)$ with proper diagrams.

Turn over

10. Briefly explain about the two types of wave motion.

11. Write down the general expression for a plane progressive wave traveling in :

    (a) Positive x direction ; and

    (b) Negative x direction.

12. With proper examples explain simple harmonic motion.

(Ceiling 20)

Section B (Paragraph / Problem Type)

Answer **all** *questions in* **a paragraph** *of about* **half a page to one page**, *each correct answer carries a maximum of* 5 *marks.*

13. A small weight of mass $\boldsymbol{m}$ hangs from a string in an automobile which accelerates at rate $\boldsymbol{A}$. What is the static angle of the string from the vertical, and what is its tension ? Analyze the problem both in an inertial frame and in a frame accelerating with the car.

14. Explain the Foucault pendulum. Calculate the time it will take the plane of oscillation of a Foucault's pendulum to turn through 90° at a point where the co-latitude is 60°.

15. Find the spring constant $\boldsymbol{k}$ and damping constant $\boldsymbol{b}$ of a damped oscillator having a mass of 5 kg, frequency of oscillation 0.5 Hz, and logarithmic decrement 0.02.

16. A satellite of mass m = 2000 kg is in elliptic orbit about the earth. At perigee it has an altitude of 1100km and at apogee its altitude is 4100 km. Calculate the energy needed to put the satellite into orbit by neglecting losses due to friction.

17. The centre of mass of a 1600 kg car is midway between the wheels and 0.7 m above the ground. The wheels are 2.6 m apart.

    (a) What is the minimum acceleration A of the car so that the front wheels just begin to lift off the ground ?

    (b) If the car decelerates at rate g, what is the normal force on the front wheels and on the rear wheels ?

18. Evaluate the time average values of the potential and kinetic energies of a frictionless harmonic oscillator.

19. Define Q factor of an oscillator. A musician's tuning fork rings at $\boldsymbol{A}$ above middle $\boldsymbol{C}$, 440 Hz. A sound level meter indicates that the sound intensity decreases by a factor of 5 in 4 s. Calculate the $\boldsymbol{Q}$ of the tuning fork.

(Ceiling 30)

Section C (Essay Type)

Essays-Answer in about **two pages**, *any* **one** *question. Answer carries* 10 *marks.*

20. State Fourier's theorem ? Determine the values of Fourier's co-efficients. What are conditions of its applicability. Discuss Fourier analysis of a non-periodic function with suitable plots.

21. State and prove Kepler's laws of planetary motion. Show that the areal velocity of a planet around the sun is constant.

(1 × 10 = 10 marks)

C 22101 **(Pages : 3)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION, APRIL 2022

Physics/Applied Physics

PHY 2B 02/APH 2B 02—MECHANICS—II

(2021 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the question paper have their usual meanings.

Section A

Answer atleast **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall ceiling 24.

1. Define the time average of a function $f(t)$ with proper diagrams.
2. Explain Coriolis force. What is the effect of Coriolis force on wind moving over the surface of earth?
3. Briefly explain the characteristic impedance of a travelling wave.
4. Explain the terms :
   (a) Apogee, and
   (b) Perigee.
5. Define :
   (a) Phase velocity, and
   (b) Group velocity.
6. Write the equation of a forced damped harmonic oscillator and describe the terms involved.
7. Define central force motion and list any two features of central force motion.
8. Discuss the condition for non-dispersive wave.
9. Two particles are interacting under a central force. Explain how a two-body problem can be reduced to a one-body problem.
10. Briefly explain about the two types of wave motion.

Turn over

11. State and explain the principle of equivalence.

12. With proper examples explain simple harmonic motion.

(8 × 3 = 24 marks)

Section B

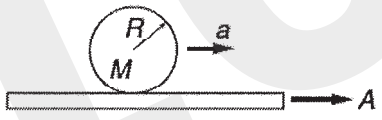
Answer atleast **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall ceiling 25.

13. State and prove Kepler's third law.

14. Explain the Foucault pendulum. Calculate the time it will take the plane of oscillation of a Foucault's pendulum to turn through 90º at a point where the co-latitude is 60º.

15. Find the spring constant k and damping constant b of a damped oscillator having a mass of 5 kg, frequency of oscillation 0.5 Hz, and logarithmic decrement 0.02.

16. A cylinder of mass M and radius R rolls without slipping on a plank that is accelerated at rate A. Find the acceleration of the cylinder.



17. The centre of mass of a 1600 kg car is midway between the wheels and 0.7 m above the ground. The wheels are 2.6 m apart.

    (a) What is the minimum acceleration A of the car so that the front wheels just begin to lift off the ground ?

    (b) If the car decelerates at rate g, what is the normal force on the front wheels and on the rear wheels ?

18. Explain the Q factor of an oscillator. In one experiment, a paper weight suspended from a hefty rubber band had a period of 1.2 s and the amplitude of oscillation decreased by factor 2 after three periods. What is the estimated Q of this system ?

19. Discuss Newton's model to determine the velocity of sound in air. Account for the correction required to obtain observed result.

(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*
The question carries 11 *marks.*

20. Establish the differential equation of motion for a damped harmonic oscillator and write down the general solution for displacement for oscillatory motion and sketch it. Show that the energy falls exponentially with time.

21. State Fourier's theorem. Determine the values of Fourier's coefficients. What are conditions of its applicability ? Discuss Fourier analysis of a non-periodic function with suitable plots.

(1 × 11 = 11 marks)

C 4393-B **(Pages : 2)** **Name.....**

Reg. No.....

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2021

Physics/Applied Physics

PHY 2B 02/APH 2B 02—MECHANICS—II

(2020 Admissions)

Time : Two Hours Maximum : 60 Marks

The symbols used in the question paper have their usual meanings.

Section A (Short Answer Type)

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Define fictious force ? Deduce an expression for the force experienced by a particle in a co-ordinate system with uniform acceleration A.
2. State and explain the principle of equivalence.
3. Define inertial and non-inertial frame of references with proper examples.
4. Explain what is meant by the Galilean transformations.
5. What is a central force ? Show that the motion of a particle under central force is always confined to a single plane.
6. State law of equal areas. How is it related to angular momentum ?
7. Establish the differential equation of a harmonic oscillator and write down its general solution.
8. Explain Simple Harmonic Motion and discuss its characteristics.
9. Briefly explain about (a) Phase velocity ; and (b) Group velocity
10. Differentiate between dispersive and non-dispersive sinusoidal waves.
11. Write down the general expression for a plane progressive wave traveling :
    (a) Positive x direction ; and
    (b) Negative x direction.
12. Write two important properties of travelling waves.

(8 × 3 = 24 marks)

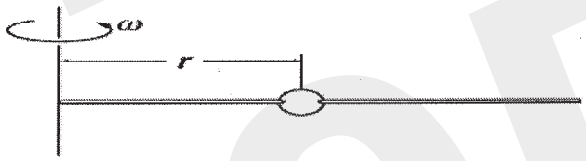
Turn over

Section B (Paragraph / Problem Type)

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. A small weight of mass m hangs from a string in an automobile which accelerates at rate A. What is the static angle of the string from the vertical, and what is its tension ? Analyze the problem both in an inertial frame and in a frame accelerating with the car.

14. A bead slides without friction on a rigid wire rotating at constant angular speed ω. Find the force exerted by the wire on the bead.



15. Define the Foucault Pendulum. If m is the mass and l is the length of the pendulum, find the time for the plane of oscillation to rotate once.

16. A satellite of mass m = 2000 kg is in elliptic orbit about the earth. At perigee (closest approach to the earth) it has an altitude of 1100 km and at apogee (farthest distance from the earth) its altitude is 4100 km. Calculate the energy needed to put the satellite into orbit by neglecting losses due to friction.

17. What are stationary satellites ? Calculate the height at which such a satellite must revolve in its orbit around the earth.

18. Evaluate the time average values of the potential and kinetic energies of a frictionless harmonic oscillator.

19. Define Q factor of an oscillator. A musician's tuning fork rings at A above middle C, 440 Hz. A sound level meter indicates that the sound intensity decreases by a factor of 5 in 4 s. Calculate the Q of the tuning fork.

(5 × 5 = 25 marks)

Section C (Essays)

Answer any **one** *question.*
The question carries 11 *marks.*

20. What is a Pulse ? Discuss Fourier analysis of a non-periodic function with suitable plots.

21. State and prove Kepler's laws of planetary motion. Show that the areal velocity of a planet around the sun is constant.

(1 × 11 = 11 marks)